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Eighteen species of *Graphidaceae* new to Nepal

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Abstract—Eighteen graphidoid lichen species in *Diorygma, Graphis, Pallidogramme,* and *Phaeographis* are reported as new records from Nepal. Diagnostic characters of each species are discussed and supported by chemistry, ecology, and distribution. An identification key is provided to the 24 graphidaceous species recorded from Nepal.

Key words—Kathmandu, lichenized fungi, lirellate, taxonomy

Introduction

Molecular studies have provided a broad framework for *Graphidaceae* and produced numerous nomenclatural changes and rearrangements. These have resulted in the fusion of several concepts, with some old or obsolete taxa resurrected and many new taxa described (Staiger & Kalb 1999; Staiger 2002; Staiger & al. 2006; Lücking & al. 2009, 2013; Mangold & al. 2008, 2009; Rivas Plata & Lumbsch 2011, Rivas Plata & al. 2012a,b, 2013; Kraichak & al. 2014; Lumbsch & al. 2014a,b). As currently accepted, *Graphidaceae* represents the second largest lichen family, with 2161 species distributed among 79 genera (Lücking & al. 2017).

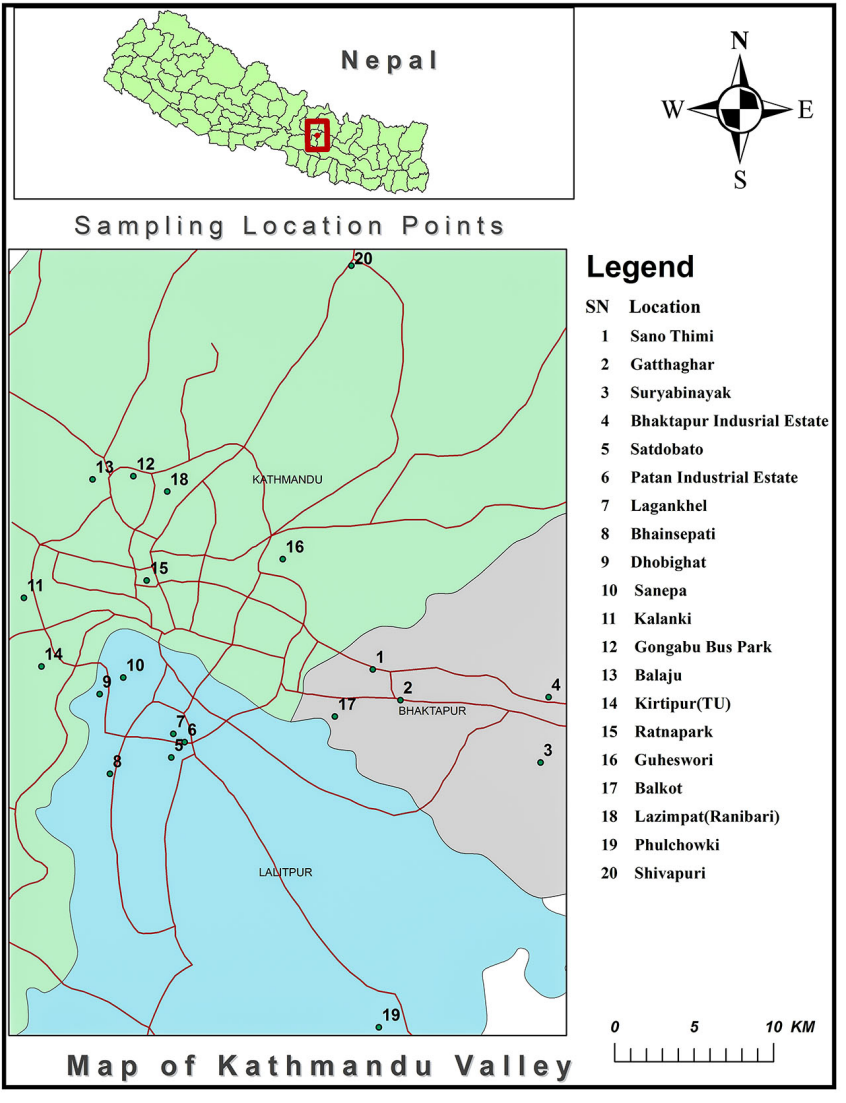
Lichenological studies in Nepal have been conducted by primarily western and a few native lichenologists (Lamb 1966; Bystrek 1969; Abbayes 1974; Poelt 1974; Jahns & Seelen 1974; Kurokawa 1974; Mitchell 1974; Schmidt 1974; Vězda & Poelt 1975; Awasthi 1986, 1991, 2007; Awasthi & Mathur 1987; Sharma 1995; Baniya & al. 2001; Olley & Sharma 2013), and a total of 820 species of lichenized-fungi have been recorded from the country (Olley & Sharma 2013, Rai et al 2016). However, the crustose lichens have been little studied, particularly the family *Graphidaceae* with lirellate taxa, for which only six species—*Glyphis cicatricosa* Ach., *Graphis chlorotica* A. Massal., *G. proserpens* Vain., *G. scripta* (L.) Ach., *G. tenella* Ach., and *Platythecium pyrrhochroum* (Mont. & Bosch.) Z.F. Jia & Lücking—have been recorded from Nepal (Olley 2008, Olley & Sharma 2013, Rai & al. 2016). The present study covers species of graphidoid (lirellate) lichens collected from central Nepal and reported as new to the country.

Including the 18 new records described in this paper, 24 species in *Graphidaceae* are now known from Nepal. We refrain from including *Phaeographina nepalensis* D.D. Awasthi & Kr.P. Singh described from Nepal (Awasthi & Singh 1973), because its identity is uncertain; it may represent a *Graphis* species with striate labia, although brown ascospores are rare in the genus. Two other names previously reported from Nepal are included as synonyms: *Graphis subglauconigra* Nagarkar & Patw. has been synonymised with *G. tenella* (Lücking & al. 2009); and *Phaeographina pyrrhochroa* is a homotypic synonym of the new combination *Platythecium pyrrhochroum* (Jia & Lücking 2017). Three newly reported species extend across Asia from the Neotropics to the Eastern Palaeotropics. The amount of interesting material in our collections suggests an extraordinary diversity of *Graphidaceae* in Nepal and indicates the need for further lichenological investigations in unexplored areas of the country.

Materials & methods

The study sites were located in different areas around Kathmandu Valley in the Bagmati Zone of Central Nepal (Map 1). The valley is roughly 650 km^2 with elongated east west; its average elevation is c. 1350 m and annual precipitation averages 1343 mm (Shakya & al. 2014).

Initially, a GIS based sampling map of Kathmandu was designated (Map 1) to locate the 20 study sites. Samples were collected from all the sites based on availability of lichens on barks. The collected material was processed for curation using standard lichenological procedures (Awasthi 2000), and the voucher specimens



Map 1. Sampling areas in the Kathmandu Valley of Nepal.

were deposited at the National Herbarium Laboratory, Godavari, Kathmandu, Nepal (KATH). Specimens were examined and identified at the Lichenology laboratory, CSIR-National Botanical Research Institute, Lucknow, India. Diagnostic characters

were observed with standard light microscopy techniques using a Leica™ S8APO stereomicroscope and Leica™ DM500 optical microscope. Thallus and ascocarp sections were mounted in water, 10% KOH, and lactophenol blue; Lugol's solution was used to check amyloidity (I+ or I–). All measurements were made in water. Chemical constituents were identified by spot color reaction tests and thin layer chromatography (TLC; solvent system A) following published protocols (Elix & Ernst-Russel 1993, Orange & al. 2001). Measurements of hymenium, exciple, asci, and ascospores (5-10 ascospores measured per sample) were made on 5–10 thin, hand-cut apothecial sections per collection. Specimen identifications, nomenclatural changes, and new records were validated against relevant keys, monographs, and checklists (Archer 2005; Lücking & al. 2009; Singh & Sinha 2010; Joshi et al. 2013a,b; Olley & al. 2013; Mishra & al. 2016). Terms used to define lirellae morphs follow Lücking & al. (2009).

Taxonomy

Diorygma hieroglyphicum (Pers.) Staiger & Kalb,
Symb. Bot. Upsal. 34(1): 151, 2004. Pl. 1a

Thallus corticolous, crustose, greenish-white, smooth to uneven, 120–140 µm thick; photobiont *Trentepohlia*; ascomata lirellate, lirellae emergent to semi-emergent, white, straight to curved, simple to branched, 2.0–3.5 × 0.3–0.5 mm, with indistinct thalline margin; disc broad, concealed, flat to concave, white pruinose, 0.2–0.4 mm in diam.; proper exciple hyaline to pale-brown, divergent, poorly developed; hymenium hyaline, clear; asci 1-spored; ascospores hyaline, amyloid (I+ blue), muriform, with unequal locules, 95–150 × 30–40 µm.

Chemistry—Thallus K+ yellow orange, Pd+ reddish, C–, KC–. Stictic acid detected with TLC.

Ecology—*Diorygma hieroglyphicum* was found growing on the barks of *Alnus nepalensis* D. Don (*Betulaceae*) and *Castanopsis indica* (Roxb. ex Lindl.) A. DC. (*Fagaceae*) at 1600–1900 m near the buffer zone of Shivapuri National Park and of Phulchowki forest area.

Specimens examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°35′05″N 85°22′42″E, alt. 1626 m, on tree bark, 1 December 2016, Neena Karmacharya 16–134 (KATH); Phulchowki, 27°34′47″N 85°23′09″E, alt. 1936 m, on tree bark, 1 December 2016, Neena Karmacharya 16–148 (KATH).

Comments—Our Nepalese specimens corresponded closely to previously published descriptions of *D. hieroglyphicum*. This pantropical species has been recorded in Nepal, India, Vietnam, Australia, Cameroon, New Caledonia, Tanzania, Indonesia, Singapore, Papua New Guinea, the Philippines, Vanuatu, and the Solomon Islands (Archer 2009, Kalb & al. 2004, Joshi & al. 2013a).

Diorygma junghuhnii (Mont. & Bosch.) Kalb, Staiger & Elix, Symb. Bot. Upsal. 34(1): 157, 2004. Pl. 1B

Thallus corticolous, crustose, white, creamy, pale-gray or greenish-gray, rough, dull, 75–90 µm thick; photobiont *Trentepohlia;* ascomata lirellate, lirellae emergent, curved, simple to branched 2–3.5 × 0.5–1 mm with crenate thalline margin; disc concealed, brown to dark brown, white pruinose; proper exciple hyaline to pale-brown, slightly divergent, poorly developed; hymenium hyaline, clear; asci 1–2-spored; ascospores hyaline, amyloid (I+ violet-blue), muriform (25–31 × 6–10 locular) measuring 84–134 × 29–42 µm.

Chemistry—Thallus K+ yellow orange, Pd+ yellow-orange, C–, KC–. Norstictic and constictic acids detected with TLC.

Ecology—*Diorygma junghuhnii* was collected with many other members of *Parmeliaceae* and *Physciaceae* at c. 1600 m in the Phulchowki forest area.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°35′05″N 85°22′42″E, alt. 1626 m, on tree bark, 19 December 2016, Neena Karmacharya 16–089A (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *D. junghuhnii,* the most common *Diorygma* species. This pantropical species has previously been reported from India, China, Vietnam, Japan, the Philippines, Indonesia, Australia, New Caledonia, Tanzania, Brazil, Costa Rica, Guatemala, Paraguay, Solomon Islands, Tahiti, and Thailand (Kalb & al. 2004, Joshi & al. 2013b).

Graphis antillarum Vain., Hedwigia 38: 255, 1899. Pl. 1C

Thallus corticolous, crustose, whitish-gray, rough; photobiont *Trentepohlia;* ascomata lirellate, lirellae appear whitish-gray due to broken thalline cover studded in furrows of labia, erumpent, elongate, curved, simple to irregularly branched (*tenella*-morph), 2–8 × 0.2 mm in size with thick lateral thalline margin; labia striate; proper exciple laterally carbonized; hymenium hyaline, clear; asci 2–8-spored; ascospores hyaline, amyloid (I+ blue), muriform, 30–60 × 17–25 µm.

Chemistry—Thallus K+ yellow turning red, Pd+ yellow-orange, C–, KC–; norstictic acid detected with TLC.

Ecology—*Graphis antillarum* was collected from the bark of *Rhododendron* spp. (*Ericaceae*) in the Shivapuri National Park at c. 1800 m.

Specimen Examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°46′49″N 85°22′56″E, alt. 1875 m, on tree bark, 11 February 2017, Neena Karmacharya 17–207C (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. antillarum*. This cosmopolitan species was previously reported from Germany and Costa Rica (Lücking & al. 2008, 2009).

Graphis breussii G. Neuwirth & Lücking, Lichenologist 41: 272, 2009. Pl. 1d

Thallus corticolous, crustose, rough, gray to whitish-gray with dull surface; photobiont *Trentepohlia;* ascomata lirellate, lirellae elongate, curved, prominent, simple to irregularly branched (*acharii*-morph), 6–10 × 0.3–0.5 mm, with apically thin complete and conspicuous thalline margin; labia striate, convergent; proper exciple completely carbonized, deeply incised with thalline cover; hymenium hyaline, clear; asci 4-spored; ascospores hyaline, muriform (7–11 × 1–2 locular), amyloid (I+ blue-violet), 30–45 × 9–12 µm.

Chemistry—Thallus K+ yellow turning red, Pd+ yellow-orange, C–, KC–. Norstictic acid detected with TLC.

Ecology—*Graphis breussii* was found growing among other foliose and crustose lichens on bark of *Alnus nepalensis* and collected from Phulchowki at c. 1600 m.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°35′05″N 85°22′42″E, alt. 1626 m, on tree bark, 19 December 2016, Neena Karmacharya 16–093C (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. breussii*. This new continental record was previously known from southern Venezuela (Lücking & al. 2009).

Graphis cincta (Pers.) Aptroot, Fl. Australia 57: 651, 2009. Pl. 1e

Thallus corticolous, crustose, off-white to pale-fawn, smooth, dull; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent, numerous, scattered, elongate, straight to curved or sinuous, simple, 0.5–2.0 × 0.1–0.2 mm, with a conspicuous basal to lateral thalline margin (*lineola*-morph); disc concealed, rarely slightly open; labia entire; proper exciple laterally carbonized; hymenium hyaline, inspersed with oil droplets; asci 8-spored; ascospores hyaline, amyloid (I+ blue), transversely 7–11-septate, measuring 25–40 × 7–10 µm.

Chemistry—Thallus K+ yellow turning red, Pd+ yellow-orange, C–, KC–. Norstictic acid detected with TLC.

Ecology—*Graphis cincta* was collected from the bark of *Cinnamomum camphora* (L.) J. Presl (*Lauraceae*) near industrial site of Balaju in Kathmandu Valley at c. 1300 m.

Specimen examined – **NEPAL. Bagmati zone:** Balaju, 27°44′01″N 85°18′02″E, alt. 1310 m, on tree bark, 11 November 2016, Neena Karmacharya 16–046A (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. cincta.* It has a pantropical distribution and was previously reported from India, Australia, Paraguay, the Philippines, Taiwan, West Indies, Costa Rica, Japan, and Vanuatu (Singh & Sinha 2010; Archer 2009; Lücking & al. 2008, 2009).

Graphis cleistoblephara Nyl., Ann. Sci. Nat., Bot., Sér. 4, 20: 265, 1863. Pl. 1f

Thallus corticolous, crustose, gray to pale-gray, fawn colored, thin, smooth, dull; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent, conspicuous, numerous, scattered, very short, unbranched, sessile, straight, 0.5–0.2 × 0.3–0.5 mm, with a thick conspicuous lateral thalline margin (*dussii*-morph); disc concealed; labia entire; proper exciple completely carbonized; hymenium: hyaline, clear; asci 2–4-spored; ascospores hyaline, amyloid (I+ blue), muriform (19–23 × 2–5 locular) measuring 85–120 × 15–20 µm.

Chemistry—Thallus K+ yellow turning red, Pd+ yellow-orange, C–, KC–. Norstictic acid detected with TLC.

Ecology—*Graphis cleistoblephara* occurs most commonly on the bark of *Acer oblongum* Wall. ex DC. (*Aceraceae*) at c. 1300 m in the Ranibari area of Kathmandu.

Specimen examined – **NEPAL. Bagmati zone:** Ranibari, 27°43′49″N 85°19′15″E, alt. 1326 m, on tree bark, 13 October 2016, Neena Karmacharya 16–016 (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. cleistoblephara.* The pantropical species has been recorded from India, Australia, China, Indonesia, Japan, Mexico, the Philippines, and Sri Lanka (Lücking & al. 2009, Singh & Sinha 2010).

Graphis galactoderma (Zahlbr.) Lücking, Lichenologist 41: 436, 2009. Pl. 1g

Thallus corticolous, crustose, white to pale-yellow, smooth to cracked; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent to prominent, crowded, curved, simple to sparsely branched, 3–6 × 0.2 mm, with lateral thalline margin (*lineola*-morph); labia 1–4 striate; proper exciple apically (to peripherally) carbonized; hymenium hyaline, clear; asci 8-spored; ascospores hyaline, amyloid (I+ blue), muriform, 20–45 × 9–16 µm.

Chemistry—Thallus K+ yellowish, Pd+ orange, C–, KC–. Stictic acid detected with TLC.

Ecology—*Graphis galactoderma* was common among the *Quercus semecarpifolia* Sm. (*Fagaceae*) forest area in Phulchowki forest area above 2000 m.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°34′46″N 85°23′31″E, alt. 2156 m, on tree bark, 04 February 2017, Neena Karmacharya 17–158B (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. galactoderma*. The species is common in eastern paleotropics and has been recorded from the tropical regions of India and China (Lücking & al. 2009, Archer 2009).

Graphis leprographa Nyl., Acta Soc. Sci. Fenn. 26(10): 21, 1900. Pl. 1h

Thallus corticolous, crustose, white to yellowish-gray, smooth to uneven; photobiont *Trentepohlia;* ascomata lirellate, lirellae prominent, simple, crowded, very short, unbranched with thick lateral thalline margin (*dussii*-morph); labia entire; proper exciple completely carbonized; hymenium hyaline, clear; asci 1–2-spored; ascospores hyaline, amyloid (I+ blue), muriform, 60–110 × 15–30 µm.

Chemistry—Thallus K+ yellow turning red, Pd+ yellow-orange, C–, KC–. Norstictic acid detected with TLC.

Ecology—*Graphis leptographa* was found growing in association with some leprose taxa and collected from the bark of *Alnus nepalensis* at c. 1600 m in the buffer zone of the Shivapuri National Park.

Specimen examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°47′30″N 85°22′15″E, alt. 1647 m, on tree bark, 19 December 2016, Neena Karmacharya 16–133A/c (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. leptographa*. It has pantropical distribution and recorded previously from Sri Lanka, Costa Rica, and Seychelles (Lücking & al. 2008, 2009).

Graphis lineola Ach., Lich. Univ.: 264, 1810. Pl. 1i

Thallus corticolous, crustose, whitish-gray, smooth, dull; photobiont *Trentepohlia*; ascomata lirellate, lirellae erumpent, numerous, simple to sparsely branched with lateral thalline margin (*lineola*-morph), 0.5–3 × 0.1–0.3 mm; disc concealed; labia entire; proper exciple laterally carbonized; hymenium hyaline, inspersed with oil-droplets; asci 8-spored; ascospores hyaline, amyloid (I+ blue), transversely 5–11-septate, 60–110 × 15–30 µm.

Chemistry—Thallus K–, Pd–, C–, KC–. No substances detected with TLC.

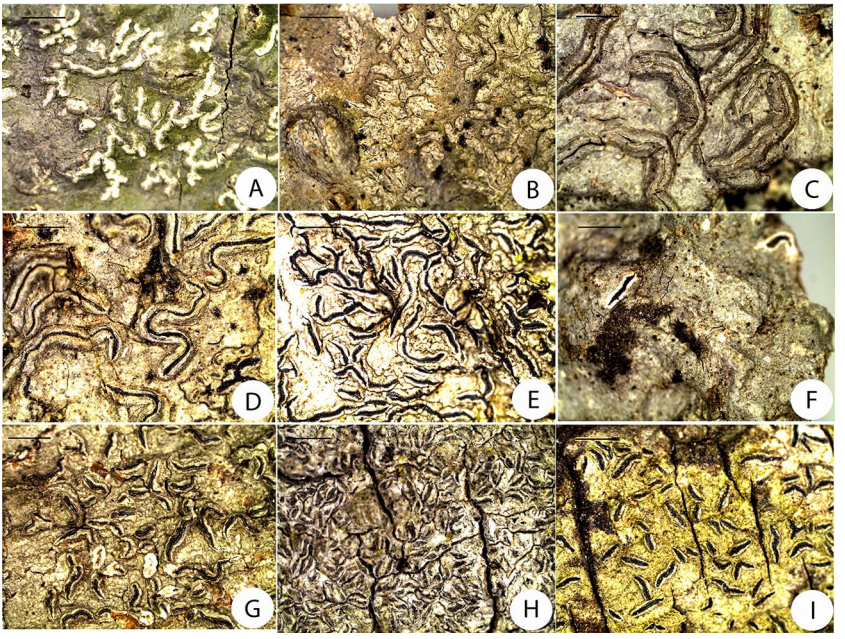


Plate 1. New records in *Graphidaceae* from Nepal. A. *Diorygma hieroglyphicum*; B. *D. junghuhnii*; C. *Graphis antillarum*; D. *G. breussii*; E. *G. cincta*; F. *G. cleistoblephara*; G. *G. galactoderma*; H. *G. leprographa*; I. *G. lineola*. Scale bars: A, B, G = 2 mm; C–F, H, I = 1 mm.

Ecology—*Graphis lineola* was collected from the bark of *Pinus roxburghii* Sarg. (*Pinaceae*) growing along the roadside at c. 1300 m in the Bhaisepati area of Kathmandu.

Specimen examined – **NEPAL. Bagmati zone:** Bhaisepati, 27°39′13″N 85°18′19″E, alt. 1344 m, on tree bark, 24 November 2016, Neena Karmacharya 16–109B (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. lineola,* which occurs commonly in the tropics and has been recorded from India, China, Costa Rica, Taiwan, West Indies, and Portugal (Lücking & al. 2009, Singh & Sinha 2010, Lepista & Aptroot 2016).

Graphis paradisserpens Sipman & Lücking, Fieldiana, Bot. 46: 96, 2008. Pl. 2a

Thallus corticolous, crustose, creamy white to pale-gray, smooth to uneven, dull; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent, very long, curved, radiately branched, 2–8 × 0.2–0.3 mm, lacking or with basal thalline margin (*sorediosa*-morph); disc concealed; labia striate; proper exciple apically

(to peripherally) carbonized; hymenium hyaline, clear; asci 2–8-spored; ascospores hyaline, amyloid (I+ blue), submuriform (5–7 × 0–2 locular), 25–40 × 8–15 µm.

Chemistry—Thallus K–, Pd–, C–, KC–. No substances detected with TLC.

Ecology—*Graphis paradisserpens* was collected from the bark of *Alnus nepalensis* at c. 1600 m in the Phulchowki forest area.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°35′05″N 85°22′42″E, alt. 1626 m, on tree bark, 16 December 2016, Neena Karmacharya 16–093A/a (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. paradisserpens*. The species was previously reported from the neotropical regions of Costa Rica and the West Indies (Lücking & al. 2009). Our report represents a new record for Asia.

Graphis paraserpens Lizano & Lücking, Fieldiana, Bot. 46: 96, 2008. Pl. 2B

Thallus corticolous, crustose, gray to pale-gray, smooth to uneven; photobiont *Trentepohlia;* ascomata lirellate, lirellae emerged to erumpent, elongate, straight to flexuose, simple to irregularly branched with apically thin complete thalline margin (*symplecta*-morph), 2–5 × 0.2–0.3 mm; disc concealed; labia striate; proper exciple apically (to peripherally) carbonized; hymenium hyaline, clear; asci 2–6-spored; ascospores hyaline, amyloid (I+ blue), muriform, 30–40 × 9–12 µm.

Chemistry—Thallus K–, Pd–, C–, KC–. No substances detected with TLC.

Ecology—*Graphis paraserpens* was collected from the bark of *Schima wallichii* Choisy (*Theaceae*) at c. 1700 m in the forested area of Shivapuri National Park.

Specimen examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°47′27″N 85°22′23″E, alt. 1706 m, on tree bark, 11 February 2017, Neena Karmacharya 16–182 (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. paraserpens*. The species is new to palaeotropical region and has been reported from Brazil and Costa Rica (Lücking & al. 2008, 2009).

Graphis pertricosa (Kremp.) A.W. Archer, Telopea 11: 73, 2005. Pl. 2C

Thallus corticolous, crustose, off-white to fawn, smooth to verrucose, dull; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent, straight

to curved or sinuous, numerous, scattered, short and simple to sparsely branched with apically thin complete thalline margin (*negrosina*-morph), 1–2.5 × 0.1–0.3 mm; disc concealed; labia entire; proper exciple laterally carbonized; hymenium hyaline, inspersed with oil-droplets; asci 8-spored; ascospores hyaline, amyloid (I+ blue), muriform (6–9× 1–3 locular), 25–40 × 8–12 µm.

Chemistry—Thallus K+ yellow turning red, Pd+ reddish, C–, KC–. Norstictic acid detected with TLC.

Ecology—*Graphis pertricosa* was common on the bark of *Castanopsis indica* at c. 2000 m in the valley of the Phulchowki forest area.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°34′46″N 85°23′31″E, alt. 2156 m, on tree bark, 24 February 2017, Neena Karmacharya 16–163A (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. pertricosa.* The species is common in eastern palaeotropical countries including Australia (Lücking & al. 2009) and has also been reported from India, Indonesia, Malaysia, and Tanzania (Archer 2009, Singh & Sinha 2010).

Graphis pinicola Zahlbr., Symb. Sin. 3: 43, 1930. Pl. 2D

Thallus corticolous, crustose, white to whitish-gray, smooth to verrucose; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent to prominent, short to elongate, straight to curved, sparsely and irregularly or branched with lateral thalline margin (*lineola*- or *deserpens*-morph), 1–4 × 0.1–0.3 mm; disc concealed; labia entire; proper exciple laterally carbonized; hymenium hyaline, clear; asci 8-spored; ascospores hyaline, amyloid (I+ blue), transversely 8–10-septate, 25–35 × 10–12 µm.

Chemistry—Thallus K–, Pd–, C–, KC–. No substances detected with TLC.

Ecology—*Graphis pinicola* was collected from the bark of *Schima wallichii*, where it was growing in association with *Graphis paraserpens* and other corticolous lichenized and non-lichenized fungi at c. 1700 m in the Shivapuri National Park of Kathmandu.

Specimen examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°47′27″N 85°22′23″E, alt. 1706 m, on tree bark, 11 February 2017, Neena Karmacharya 17–200A (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. pinicola.* The pantropical species has been reported also from India, China, Bolivia, and Thailand (Lücking & al. 2009, Singh & Sinha 2010).

Graphis stenotera Vain., Ann. Acad. Sci. Fenn., Ser. A, 15: 243, 1921. Pl. 2e

Thallus corticolous, crustose, off-white to whitish-gray, smooth, dull, slightly rimose; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent to prominent, scattered, straight, curved to sinuous, simple to sparsely branched lacking lateral thalline margin, 1–3 × 0.15–0.3 mm; disc concealed; labia striate (*striatula*-morph), non-pruinose; proper exciple apically carbonized; hymenium hyaline, clear; asci 8-spored; ascospores hyaline, amyloid (I+ blue), transversely 6–9-septate, 20–35 × 6–9 µm.

Chemistry—Thallus K+ yellow, Pd+ yellowish, C–, KC–. Stictic acid detected with TLC.

Ecology— *Graphis stenotera* was collected from the bark of *Alnus nepalensis* at c. 1600 m in the Phulchowki forest area.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°35′05″N 85°22′42″E, alt. 1626 m, on tree bark, 19 December 2016, Neena Karmacharya 16–093B (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. stenotera.* The tropical species has been reported from Nepal, India, Costa Rica, the Philippines, and Taiwan (Singh & Sinha 2010).

Graphis subvelata Stirt., Queensland Agric. J. 5: 488, 1899. Pl. 2f

Thallus corticolous, crustose, off-white to whitish-gray, smooth, dull, slightly rimose; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent, curved or sinuous, short to elongate, simple to sparsely branched with lateral thalline margin (*lineola*- or *deserpens*-morph), 1–4 × 0.1–0.3 mm; disc concealed; labia entire; proper exciple laterally carbonized; hymenium hyaline, inspersed with oil-droplets; asci 8-spored; ascospores hyaline, amyloid (I+ blue), muriform (5–10 × 1–3 locular), 35–45 × 8–15 µm.

Chemistry—Thallus K–, Pd–, C–, KC–. No substances detected with TLC.

Ecology—*Graphis subvelata* was collected from the bark of *Schima wallichii* in association with other graphidoid lichens at c. 1800 m in Shivapuri National Park in Kathmandu.

Specimen examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°47′21″N 85°22′36″E, alt. 1802 m, on tree bark, 11 February 2017, Neena Karmacharya 17–196B (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *G. subvelata.* The species has an eastern palaeotropical distribution in Nepal, New Zealand, the Philippines, Papua New Guinea, Thailand, and Australia (Archer 2009, Lücking & al. 2009).

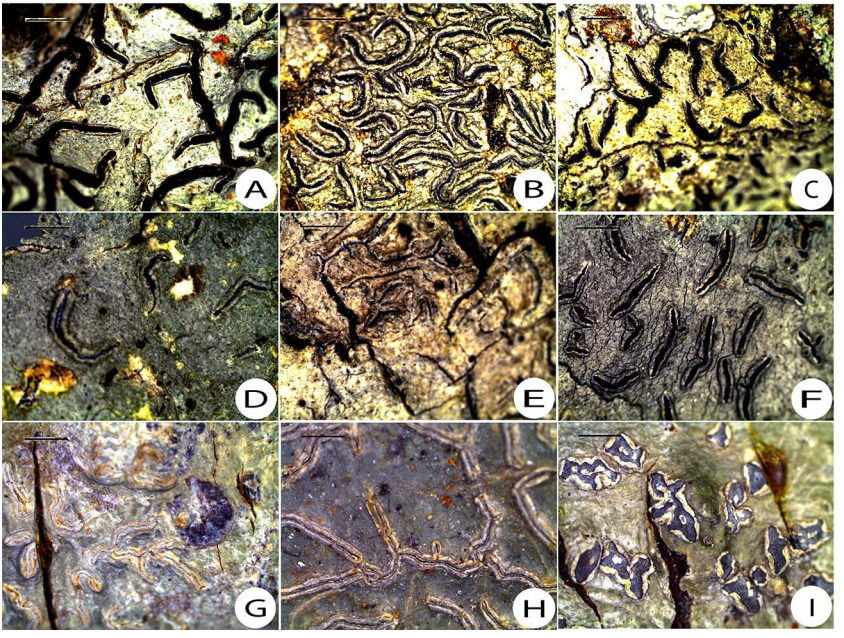


Plate 2. New records in *Graphidaceae* from Nepal. A. *Graphis paradisserpens*; B. *G. paraserpens*; C. *G. pertricosa*; D. *G. pinicola*; E. *G. stenotera*; F. *G. subvelata*; G. *Pallidogramme chrysenteron*; H. *P. divaricoides*; I. *Phaeographis leiogrammodes*. Scale bars = 1 mm.

Pallidogramme chrysenteron (Mont.) Staiger, Kalb & Lücking, Fieldiana, Bot. 46: 9, 2008. Pl. 2G

Thallus corticolous, crustose, off-white to pale-fawn, smooth, dull; photobiont *Trentepohlia;* ascomata lirellate, lirellae sessile, numerous, curved to sinuous, often branched, 1–5 × 0.4–0.6 mm; disc concealed; labia striate; proper exciple fan-shaped, yellowish-brown, convergent; hymenium hyaline, inspersed with oil-droplets; asci 8-spored; ascospores hyaline to pale-brown, non-amyloid (I– or I+ wine red), muriform (9–16 × 1–3 locular), 50–75 × 9–15 µm.

Chemistry—Thallus K+ yellow, Pd+ orange, C–, KC–. Stictic acid detected with TLC.

Ecology—*Pallidogramme chrysenteron* was found growing on the bark of *Rhododendron* spp. (*Ericaceae*) above 2000 m in the Phulchowki forest area.

Specimen examined – **NEPAL. Bagmati zone:** Phulchowki, 27°34′41″N 85°23′40″E, alt. 2240 m, on tree bark, 04 February 2017, Neena Karmacharya 17–163B (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *P. chrysenteron*. The pantropical species has been recorded also from India, Sri Lanka, China, Brazil, Colombia, Costa Rica, Guyana, Panama, Australia, the Philippines, Thailand, and Vietnam (Staiger 2002, Singh & Sinha 2010, Schiefelbein & al. 2014, Joshi & al. 2015).

Pallidogramme divaricoides (Räsänen.) Pushpi Singh & Kr.P. Singh, Lichenologist 49: 531, 2017. Pl. 2H

Thallus corticolous, crustose, gray to greenish-gray, smooth, dull; photobiont *Trentepohlia;* ascomata lirellate, lirellae erumpent to prominent, curved to sinuous, elongate, divaricately branched, ≤10 mm long; disc concealed; labia striate; proper exciple pale-brown; hymenium hyaline, inspersed with oil-droplets; asci 8-spored; ascospores hyaline, amyloid (I+ blue), transversely 5–11-septate, 25–40 × 7–11 µm.

Chemistry—Thallus K–, Pd–, C–, KC–. No substances detected with TLC.

Ecology—*Pallidogramme divaricoides* was collected from the bark of *Alnus nepalensis* at c. 1600 m in the forest area of Phulchowki.

Specimen examined – **NEPAL. Bagmati zone:**, Phulchowki, 27°35′05″N 85°22′42″E, alt. 1626 m, on tree bark, 19 December 2016, Neena Karmacharya 16–089B (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *P. divaricoides*. It has been also reported from India (Singh & Singh 2017).

Phaeographis leiogrammodes (Kremp.) Müll. Arg., Nuovo Giorn. Bot. Ital. 23: 397, 1891. Pl. 2I

Thallus corticolous, crustose, pale to creamy-white, grayish, sometimes concolorous with substratum, smooth to verrucose, continuous; photobiont *Trentepohlia;* ascomata lirellate, lirellae immersed to level with thallus, numerous, simple, short to elongate, sparsely branched, stellate with a prominent thalline margin, 1–3 × 0.1–0.5 mm; disc exposed, concave to flattened, grayish, white pruinose; proper exciple thin, indistinctly present, hyaline to yellowish; hymenium hyaline, clear; asci 8-spored; ascospores brownish, amyloid (I– or I+ wine red), submuriform (8–14 × 1–2 locular µm), ≤40 × 9–15 µm.

Chemistry—Thallus K+ orange-red, Pd+ orange, C–, KC–. Norstictic and stictic acids detected with TLC.

Ecology—*Phaeographis leiogrammodes* was collected in association with other graphidoid species from the bark of *Castanopsis indica* at c. 1800 m from Shivapuri National Park in Kathmandu.

Specimen examined – **NEPAL. Bagmati zone:** Shivapuri National Park, 27°47′21″N 85°22′36″E, alt. 1802 m, on tree bark, 11 February 2017, Neena Karmacharya 17–196A (KATH).

Comments—Our Nepalese specimen corresponded closely to previously published descriptions of *P. leiogrammodes*. The pantropical species has been recorded also from China, Costa Rica, Thailand, Ecuador, and Netherlands (Staiger 2002, Aptroot & al. 2007, Bungartz & al. 2010).

Key to the species of *Graphidaceae* recorded from Nepal

1. Proper exciple hyaline to brown, not carbonized 2
1. Proper exciple distinctly carbonized, at least in some parts 7
2. Hymenium clear 3
2. Hymenium inspersed with oil-droplets 6
3. Disc concealed;
asci 2–4-spored; ascospores brownish, 28–60 × 10–17 µm;
norstictic acid .... ***Platythecium pyrrhochroum*** [≡ *Phaeographina pyrrhochroa*]
3. Disc broadly exposed 4
4. Asci 1-spored; ascospores muriform, hyaline, 95–150 × 30–40 µm;
stictic acid ..... ***Diorygma hieroglyphicum***
4. Asci 1–8-spored; ascospores sub-muriform to muriform, hyaline to brown;
norstictic and/or stictic acids 5
5. Asci 1–2-spored; ascospores muriform, hyaline, 84–134 × 29–42 µm,
norstictic acid ..... ***Diorygma junghuhnii***
5. Ascospores 8-spored; ascospores sub-muriform, brownish, ≤40 × 9–15 µm,
norstictic and stictic acids ..... ***Phaeographis leiogrammodes***
6. Lirellae prominent to erumpent, divaricately branched;
ascospores transversely septate, hyaline, 25–40 × 7–11 µm;
no substances ..... ***Pallidogramme divaricoides***
6. Lirellae sessile, irregularly branched, often aggregate;
ascospores muriform, hyaline to pale-brown, 50–75 × 9–15 µm;
stictic acid ..... ***Pallidogramme chrysenteron***
7. Ascomata embedded in distinctly raised structures (stromata)
on thallus; ascospores transversely septate, 28–60 × 7–10 µm; no
substances ..... ***Glyphis cicatricosa***
7. Ascomata not embedded in stromata, solitary to aggregate;
ascospores transversely septate to muriform; substances present or absent 8
8. Labia entire 9
8. Labia striate 16
9. Proper exciple laterally carbonized 10
9. Proper exciple completely carbonized 15

10. Hymenium clear 11
10. Hymenium inspersed with oil-droplets 13
11. Ascospores muriform, 20–40 × 8–12 µm; lirellae with apically thin, complete thalline margin; norstictic acid ..... ***Graphis pertricosa***
11. Ascospores transversely septate 12
12. Disc partly exposed, thinly white pruinose; lirellae with lateral to complete thalline margin; ascospores, 25–60 × 7–9 µm; no substances .... ***Graphis scripta***
12. Disc concealed; lirellae with lateral thalline margin; ascospores 25–35 × 10–12 µm; no substances ..... ***Graphis pinicola***
13. Ascospores muriform, 35–50 × 8–15 µm; lirellae with lateral thalline margin; no substances ..... ***Graphis subvelata***
13. Ascospores transversely septate 14
14. Norstictic acid; lirellae with basal to lateral thalline margin; ascospores 25–40 × 7–10 µm ..... ***Graphis cincta***
14. No substances; lirellae with lateral thalline margin; ascospores 20–40 × 6–9 µm ..... ***Graphis lineola***
15. Hymenium clear; lirellae sessile with thick lateral thalline margin; ascospores muriform, 85–120 × 15–20 µm ..... ***Graphis cleistoblephara***
15. Hymenium inspersed with oil-droplets; lirellae prominent with thick lateral thalline margin; ascospores muriform 60–110 × 15–30 µm .. ***Graphis leprographa***
16. Proper exciple apically (to peripherally) carbonized 17
16. Proper exciple laterally or completely carbonized 23
17. Ascospores transversely septate 18
17. Ascospores muriform 20
18. Stictic acid; lirellae lacking thalline margin; ascospores 20–35 × 6–9 µm ..... ***Graphis stenotera***
18. No substances 19
19. Lirellae with lateral thalline margin; ascospores 28–45 × 5–8 µm ..... ***Graphis chlorotica***
19. Lirellae lacking or with basal thalline margin; ascospores 20–48 × 5–8 µm ..... ***Graphis proserpens***
20. Norstictic or stictic acids 21
20. No substances 22
21. Norstictic acid; lirellae erumpent with lateral thalline margin; ascospores 30–60 × 17–25 µm ..... ***Graphis antillarum***
21. Stictic acid; lirellae erumpent to prominent with lateral thalline margin; ascospores 20–45 × 9–16 µm ..... ***Graphis galactoderma***
22. Lirellae radiately branched, lacking or with basal thalline margin; ascospores 25–40 × 8–15 µm ..... ***Graphis paradisserpens***
22. Lirellae irregularly branched with apically thin complete thalline margin; ascospores 30–40 × 9–12 µm ..... ***Graphis paraserpens***

23. Proper exciple laterally carbonized; lirellae with lateral thalline margin; ascospores transversely septate, 20–35 × 5–7 µm; no substances ..... ***Graphis tenella*** [= ***G. subglauconigra***]
23. Proper exciple completely carbonized; lirellae with apically thin complete thalline margin; ascospores muriform, 30–45 × 9–12 µm; norstictic acid ..... ***Graphis breussii***

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